



Research Article



Analysis of Lean Manufacturing: A Cost Saving Approach in Garments Production Unit

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Abstract

Sewing process is one of the most important stages in labor intensive ready-made clothing enterprises. Quality faults occurring during this process adversely affect the product quality and product efficiency, and also increase the production cost. The aim of this study is to investigate whether the knitwear production process is under control in a knitwear production enterprise and to detect the processes with highest rates of sewing faults in sewing department and finally to make suggestions for improving the quality control. Among the Statistical Process Control methods; control list, product control chart were used in the study. "Product control chart" was used to test whether the production process is controlled in the enterprise. Furthermore, the statistical methods were employed to determine the issues that need to be done in the improvement efforts and to detect the relations between the process groups supposedly effective on faults occurring in knitwear production and the amount of faults. Also, the processes with highest amounts of sewing faults and the effects of these processes on fault rates were investigated. As a result, it was concluded that the production process was statistically not under control in the ready-made clothing enterprise. In addition, this study demonstrated that the investigation of each process group by drawing their product control charts would make significant contributions to foresee the results and prepare more effective the improvement plans.

Keywords: Sewing; Extra time for fault; Hamper monthly; Cost Rectification; Causes and Remedies

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1. Introduction

As the global economic condition changing in a rapid motion, generally in an industry more focus is given on profit margin, customer demand for high quality product and improved productivity[1]. In garment manufacturing, it is usual that there will be few rejected garments after shipment. Reasons are most of the manufacturers believed that garments are soft goods and non-repairable defect may occur due to low quality raw materials or faulty process or employee casual behavior[2]. Bangladesh at sewing section to identify reworks so as to eliminate them for saving time, cost and improved product quality[3]. By reacting quicker in minimization of reworks to make a product as per customer demand with expected quality, the company can invest less money and more costs savings[4, 5].

However, factory must have check points to control over this issue. There is no ready-made solution that can reduce rejection percentage overnight. Each order is unique. But this paper work suggests how to handle such problems and bring down rejection rate to minimum with quality production[6, 7]. As we see a lot of rejected garment after shipment, most of the organization termed these garments as rejected because those garments can't be repaired by any means[8, 9]. Reworks in the garments industry is a common works that hampers the smooth production rate and focus poor quality products having an impact on overall factory economy[10]. Minimization of reworks is a must in quality and productivity improvement. Reworks are a vital issue for poor quality product and low production rate[11]. Reworks are the non productive activities focusing on any activity that customer are not willing to pay for. Nonproductive activities describe that the customer does not consider as adding value to his product[12, 13].

Bangladesh at sewing section to identify reworks so as to eliminate them for saving time, cost and improved product quality. Sewing fault is the non-productive activities focusing on any activity that customer are not willing to pay for[14, 15]. Sewing fault in the garments industry is a common works that hampers the smooth production. Focus poor quality products having an impact on overall factory economy[16, 17]. Minimization of sewing fault is a must for quality and productivity improvement, Sewing fault is issue for poor quality product and low production rate [7]. Sewing fault increases the cost of the product, Sewing fault increase the wastes of time, Sewing fault increases of rework time, Causes of sewing fault poor product quality .So, the main purpose of this project is Minimization of the sewing fault and reworking cost save [18, 19].

2. Experimental

2.1 Methodology

We performed our work in a 8 line Garment Factory. But we have taken 1 line data to complete our study. It was well equipped with modern Sewing machineries. Each line contains 26 machines. We worked on a basic T-shirt. Our working methods are as follows. First of all we checked all the machines conditions, maintenance system and other performance. We worked for sewing a Basic T-shirt.

- (1) Accordingly we have selected 10 faults for accurate analysis.
- (2) We displayed the number of target production per hour at the end of the line.
- (3) Then we have taken data from displayed board.
- (4) We accumulated the data of per hour production after end of the day.
- (5) We filled our analytical data table & drew a graphical presentation in our research to realize the fact successfully.
- (6) By the same process we have taken 26 days data.
- (7) Then we recorded the data as well and accumulated whole month data. Our data & analytical graphical representation are presented in data analysis section.

3. Data analysis

Production per month of Basic T-shirt in 1 line Buyer name: H&M Style name: Roll up T-shirt .We have taken date from one line in one floor. During our experiment we assessed that workers' skill more or less same. There are 26 worker including helper in a line. 8 over lock machine, 7 flat lock machines, 8 plain or lock stitch machine and 1 bar tuck machine in a line.(Table.1) Here, Number of production per month, number of QC passed, Number of alter, spot, rejection are given below by the table .

Table 1 October month production

DATE	Total inspection	Total QC Pass	Alter	Spot	Rejection
3-Oct-15	1966	1844	94	22	6
4-Oct-15	3893	3697	143	39	14
5-Oct-15	3882	3689	147	35	11
6-Oct-15	3790	3641	95	38	16
7-Oct-15	3858	3702	102	40	14
8-Oct-15	3856	3699	95	47	15
10-Oct-15	3589	3385	149	39	16
11-Oct-15	3371	3188	139	33	11
12-Oct-15	3600	3457	95	40	8
13-Oct-15	3941	3769	124	40	8
14-Oct-15	3807	3625	134	36	12
15-Oct-15	3489	3344	94	34	17
18-Oct-15	3507	3321	124	46	16
19-Oct-15	2124	1991	97	27	9
20-Oct-15	2168	2042	95	22	9
21-Oct-15	2020	1894	92	25	9
22-Oct-15	1333	1189	101	32	11
24-Oct-15	829	694	102	27	6
25-Oct-15	1413	1224	148	33	8
27-Oct-15	1018	896	98	20	4
26-Oct-15	1375	1243	99	27	6
27-Oct-15	1380	1249	100	25	6
28-Oct-15	1375	1243	99	27	6
29-Oct-15	1491	1370	90	26	5
31-Oct-15	1323	1200	97	20	6
Total	67880	63898	2884	841	257

3.1. Line wise production report per hour

We see the line wise production per day data shows at graphical representation .The graphs indicate at (8-9am) production value 120, at (10-11 am) production value 100 and at after lunch the production value increase (2-3pm) where the vale is 170, we see the higher production rate at the end of day (7-8pm) where the value is 230.

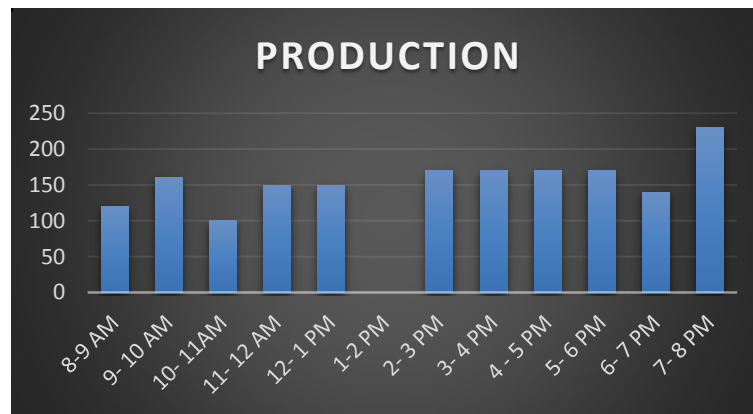


Figure 1 Line wise production report per day

So, in this line all the parameters are same except worker's performance. During our experiment we assessed that workers' skill more or less same.

3. 2. Different types of the Fault

Open seam, Down stitch, Raw edge, Up-down, Oil stain , Skip stitch, Broken stitch, Pleating, Dirty spot, Uncut thread .

3. 3. Fault wise analysis

3.3.1. Open seam

Portion of the garments that has not been covered by the sewing thread. Where the threads in the seam have ruptured leaving a hole in the stitch line. We see that the below graphs represents one month open seam faults report . And also mentioned the faults value per day in sewing line. After collected the data we observation how many times required to rework per faults. We calculated the data to rectify per month cost value for rework and yearly average losses value for per faults.

Table 2 Open seam Fault per day in per month

3- Oct-15	4- Oct-15	5- Oct-15	6- Oct-15	7- Oct-15	8- Oct-15	10- Oct-15	11- Oct-15	12- Oct-15	13- Oct-15	14- Oct-15	15- Oct-15
51	46	48	56	51	48	81	62	81	69	57	56
17- Oct-15	18- Oct-15	19- Oct-15	20- Oct-15	21- Oct-15	22- Oct-15	24- Oct-15	25- Oct-15	26- Oct-15	27- Oct-15	28- Oct-15	29- Oct-15
71	40	37	34	30	12	19	7	13	11	13	15

Table 3 Rectifying cost for open seam per month per line

Faults name	No. of faults	Time for rectifying per faults(sec)	Total time need to rectify (minute)	Cost per minute	Total cost (Taka)
Open seam	1008	45	771	3.67	2829.60

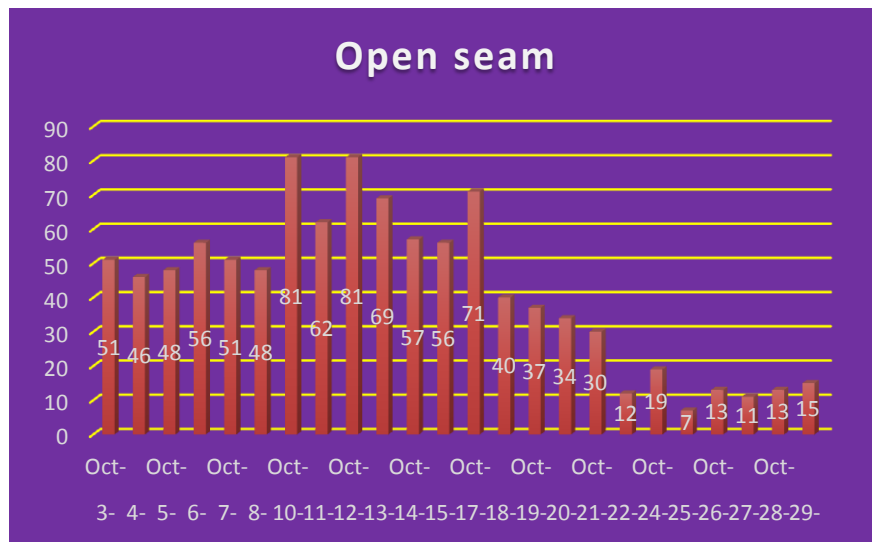


Figure 2 Open seam fault per month.

Causes and remedies for open seam

Causes

- Improper stitch for application
- Inadequate thread strength for seam and
- not enough stitches per inch.

Remedies

- Using a better quality sewing thread
- The proper size thread for the application
- Knit fabrics, check for “stitch cracking” caused by not enough stitches per inch
- Improper seam width or needle spacing for application,
- Improper stitch balance and improper thread selection.

3.3.2. Skip stitch

Where the stitch forming device misses the needle loop or the needle misses the looper loop a skipped or slipped stitch is formed. Skips are usually found where one seam crosses another seam and most of the time occurs right before or right after the heavy thickness. The below graphs show that one month skip stitch sewing faults. Whereas also mentioned specific value per day skip stitch faults in sewing line. After collected the data we calculated how much time required to rectify per faults and also analysis how much money losses in yearly to rectify.

Table 4 Skip stitch Fault per day in per month

3-Oct-15	4-Oct-15	5-Oct-15	6-Oct-15	7-Oct-15	8-Oct-15	10-Oct-15	11-Oct-15	12-Oct-15	13-Oct-15	14-Oct-15	15-Oct-15	16-Oct-15
29	54	40	52	61	58	20	44	53	51	45	24	0
17-Oct-15	18-Oct-15	19-Oct-15	20-Oct-15	21-Oct-15	22-Oct-15	24-Oct-15	25-Oct-15	26-Oct-15	27-Oct-15	28-Oct-15	29-Oct-15	31-Oct-15
42	30	29	34	21	11	14	20	22	21	22	24	23

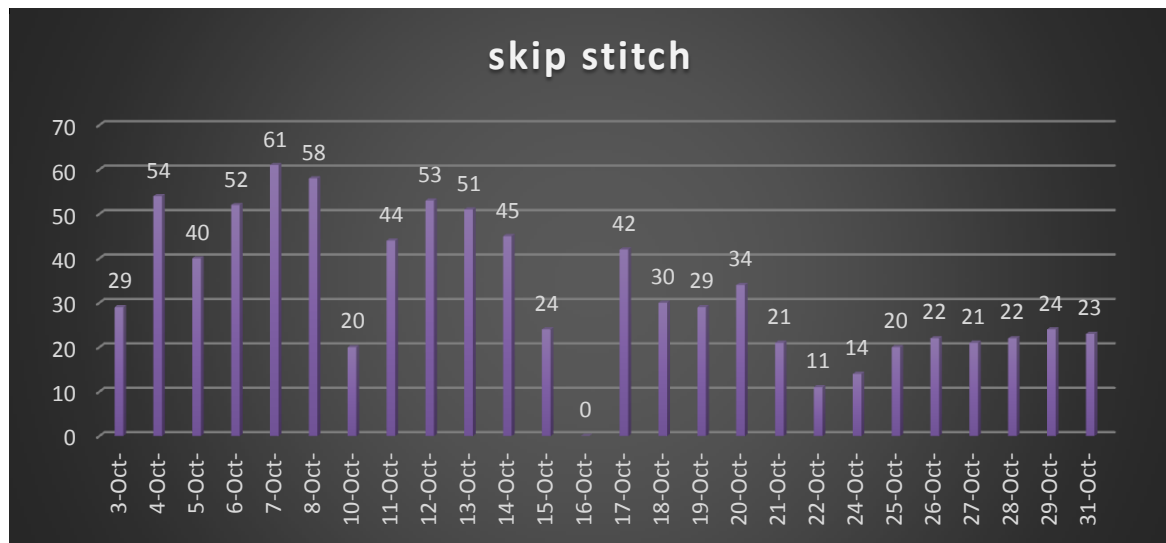


Figure 3 Skip stitch fault per month

Table 5 Rectifying cost for skip stitch per Month

Faults name	No. of faults	Time for rectifying per faults(sec)	Total time to rectify (minute)	Cost per minute(TAKA)	Total cost (Taka)
Skip stitch	844	60	899	3.67	3299

Causes and remedies for Skip stitch

Causes

- Incorrect threading.
- Needle badly inserted.
- Lack of pressure of presser foot.
- Bent needle.
- Incorrect thread twist.

Remedies

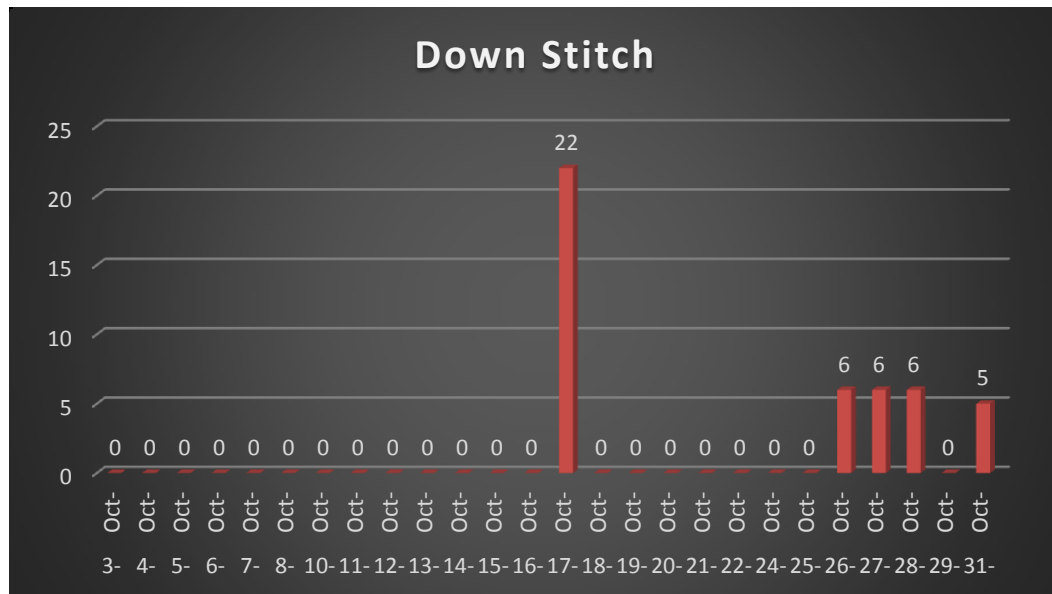
- Check and re-thread if necessary.
- Reset the needle, long groove faces the direction of threading.
- Tighten presser foot screw.
- Replace with new needle.
- Use thread with left hand twist

3.3.3. Down Stitch

When the needle loop could not have forwarded an equivalent direction line this time create down stitch. The below graphs represents the one month down stitch sewing faults. The graphs also show that individual faults value per day in a month. After collected data we calculated how many times required to rectify per faults and calculated how much losses per yearly for rework.

Table 6 Down stitch fault per month

3- Oct-15	4- Oct-15	5- Oct-15	6- Oct-15	7- Oct-15	8- Oct-15	10- Oct-15	11- Oct-15	12- Oct-15	13- Oct-15	14- Oct-15	15- Oct-15	16- Oct-15
0	0	0	0	0	0	0	0	0	0	0	0	0
17- Oct-15	18- Oct-15	19- Oct-15	20- Oct-15	21- Oct-15	22- Oct-15	24- Oct-15	25- Oct-15	26- Oct-15	27- Oct-15	28- Oct-15	29- Oct-15	31- Oct-15
22	0	0	0	0	0	0	0	6	6	6	0	5

**Figure 4** Down stitch fault per month

Causes and remedies for down stitch

Causes

- Unsincerely work
- Unadjustment of feed dog.

Remedies

- Should be work perfectly
- Feed dog adjustment correctly.

Table 7 Rectifying cost for down stitch per month

Faults name	No. of faults	Time for rectifying faults(sec)	Total time to rectify per (minute)	Cost per minute	Total cost (Taka)
Down stitch	45	75	85	3.67	312

3.3.4. Broken Stitch

Broken stitch appear as equidistant prominent horizontal lines along the width of the fabric tube when a yarn breaks or is exhausted. We see that the below graphs shows one month broken stitch sewing faults in a line. The graphs mentioned individual faults value per day. After collected the data analyze how many times required to rectify the specific faults and also observation how much losses per yearly for this rework.

Table 8 Broken stitch Fault per day in per month

3- Oct-15	4- Oct-15	5- Oct-15	6- Oct-15	7- Oct-15	8 Oct-15	10- Oct-15	11- Oct-15	12- Oct-15	13- Oct-15	14- Oct-15	15- Oct-15	16- Oct-15
12	0	0	0	0	0	0	0	0	0	0	0	0
17- Oct-15	18- Oct-15	19- Oct-15	20- Oct-15	21- Oct-15	22 Oct-15	24- Oct-15	25- Oct-15	26- Oct-15	27- Oct-15	28- Oct-15	29- Oct-15	31- Oct-15
0	0	0	11	4	0	14	14	17	10	8	6	8

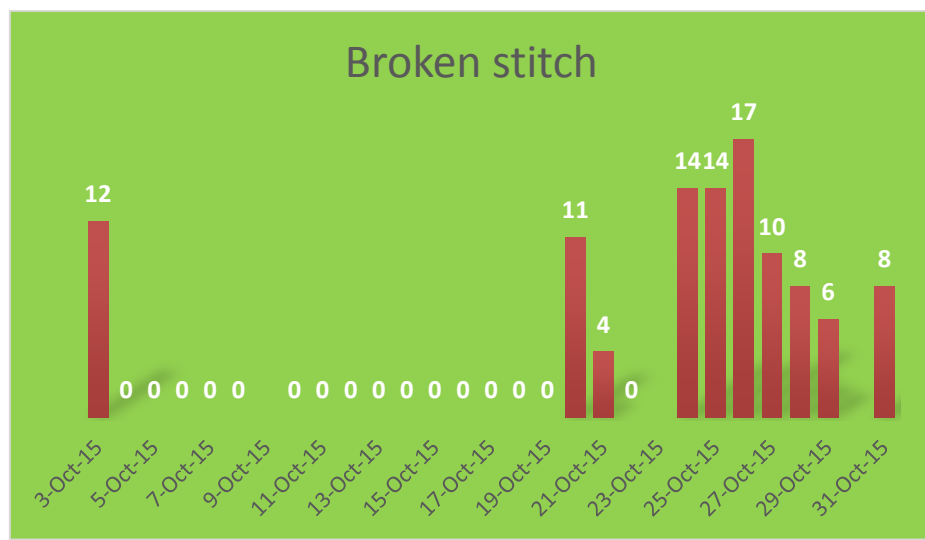


Figure 5 Broken stitch faults per month

Table 9 Rectifying cost for broken stitch per month

Fault name	No. of faults	Time for rectifying per faults(sec)	Total time to rectify (minute)	Cost per minute	Total cost (Taka)
Broken stitch	104	125	256.3	3.67	940.62

Causes and Remedies for broken stitch

Causes

- It appears due to improper trimming o machine usage.
- Uncarefully thread cutting.
- Lower thread material

Remedies

- Proper machine usage.
- Proper trimming .
- Good quality thread used.
- Carefully cutting of needed thread.
- Where the thread is being cut, use a large diameter thread on operations.

3.3.5. Raw- edge

Where the edge of the seam is either extremely "ragged" or "rolls" inside the stitch. Below this graphs show that one month raw-edge sewing faults in a production line. The graphs also highlighted the specific dated faults value. After collected the data analysis what is causes and how to way remedies this faults. And also observation how many times required per individual faults and yearly losses value for rework.

Table 10 Raw-edge Fault per day in per month

3- Oct-15	4- Oct-15	5- Oct-15	6- Oct-15	7- Oct-15	8- Oct-15	10- Oct-15	11- Oct-15	12- Oct-15	13- Oct-15	14- Oct-15	15- Oct-15	16- Oct-15
8	14	11	12	17	14	21	17	15	17	19	20	0
17- Oct-15	18- Oct-15	19- Oct-15	20- Oct-15	21- Oct-15	22- Oct-15	24- Oct-15	25- Oct-15	26- Oct-15	27- Oct-15	28- Oct-15	29- Oct-15	31- Oct-15
10	14	9	9	11	6	17	31	20	29	23	35	25

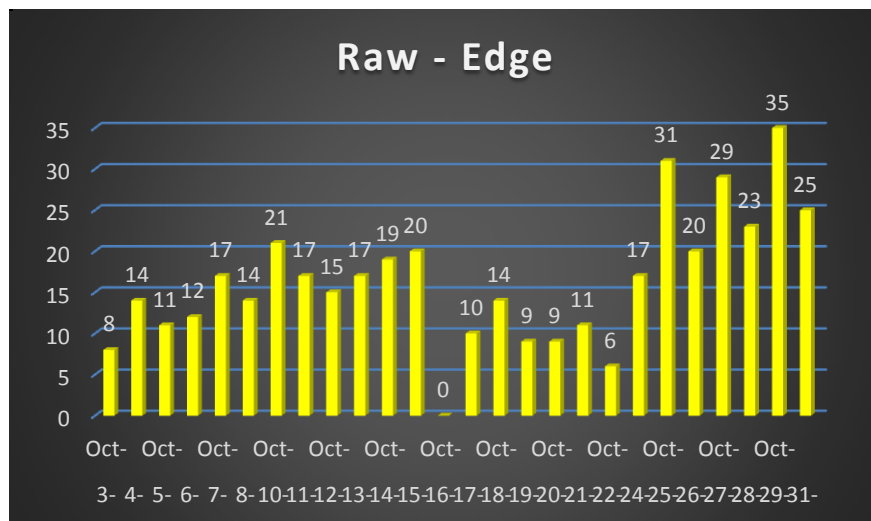


Figure 6 Raw- edge faults per month

Table 11 Rectifying cost for Raw edge per month

Faults name	No. of faults	Time for rectifying faults(sec)	Total time to rectify (minute)	Cost per minute	Total cost (Taka)
Raw- edge	447	170	1266.5	3.63	4597.395

Causes and Remedies for broken stitch

Causes

- Not working the machine knife.
- Fault of machine.
- Uncarefully work.

Remedies

- Check the machine before sewing.
- Machine knife check.
- Carefully sewing

3.3.6. Pleating

The folded edge occurred during sewing. We see that below graphs show the one month pleating sewing faults in a line. And also indicate the specific faults value per day. After collected the data we observation how many times required for rectify the faults and how much money losses yearly to rework.

Table 12. Pleating fault per day in per month with bar chart

3-Oct-15	4-Oct-15	5-Oct-15	6-Oct-15	7-Oct-15	8-Oct-15	10-Oct-15	11-Oct-15	12-Oct-15	13-Oct-15	14-Oct-15	15-Oct-15	16-Oct-15
0	0	20	0	0	0	9	0	0	0	0	0	0
17-Oct-15	18-Oct-15	19-Oct-15	20-Oct-15	21-Oct-15	22-Oct-15	24-Oct-15	25-Oct-15	26-Oct-15	27-Oct-15	28-Oct-15	29-Oct-15	31-Oct-15
4	0	0	0	0	0	0	0	0	0	0	9	0

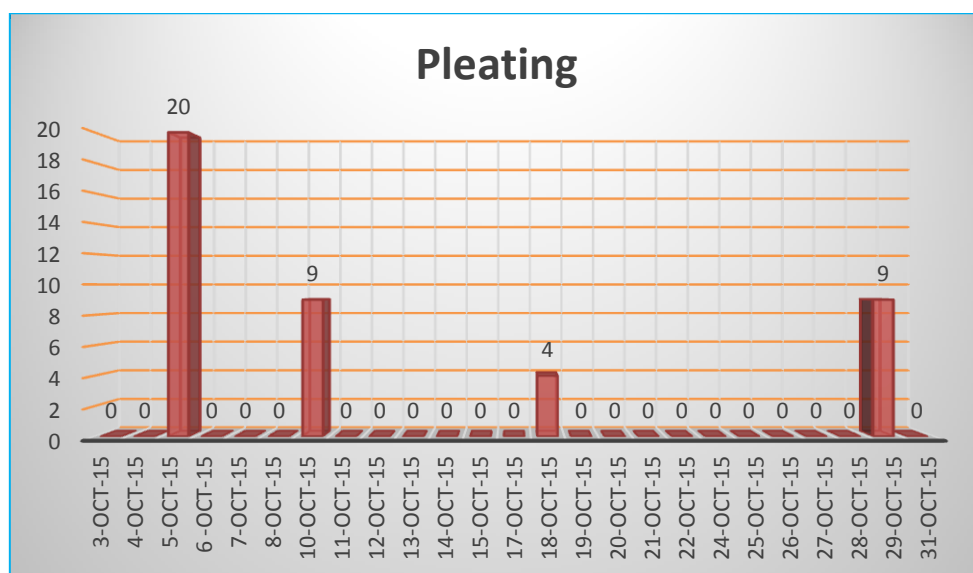


Figure 7 Pleating faults per month

Table 13 Rectifying cost for pleating per month

Faults name	No. of faults	Time for rectifying per faults(sec)	Total time to rectify (minute)	Cost per minute	Total cost (Taka)
pleating	42	25	17.5	3.63	4597.395

Causes and remedies for pleating

Causes

- Work not carefully.
- Fabric crease mark.

Remedies

- Carefully work.
- Remove crease from fabric edge.

This below table show that the average faults value per month. Where we see that the higher faults value open seam i.e whose value is 40.76 and the lowest value is down stitch faults i.e the value is 1.96 . and also we see the raw-edge and pleating average rating value is similar. The second highest average faults value is skip stitch i.e the value is 34.76.

Table 14 Average fault rating per day in 6 faults

Open seam	Skip stitch	Down stitch	Broken stitch	Raw edge	Pleating
40.76	34.76	1.96	11.1818	17.48	17.875

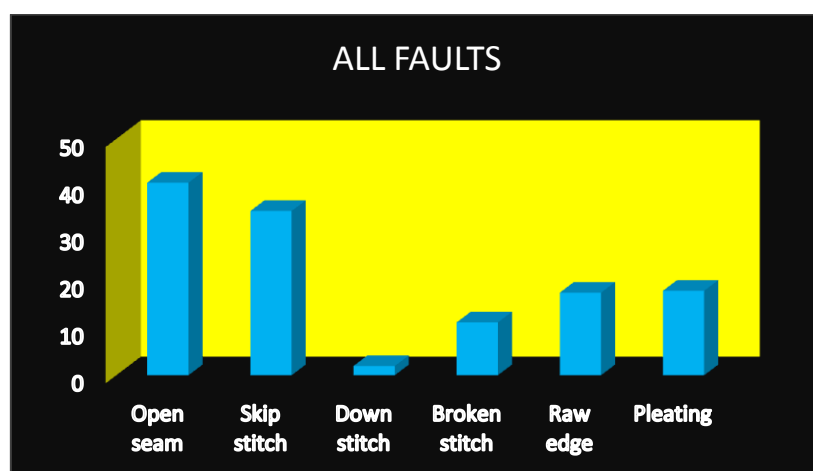
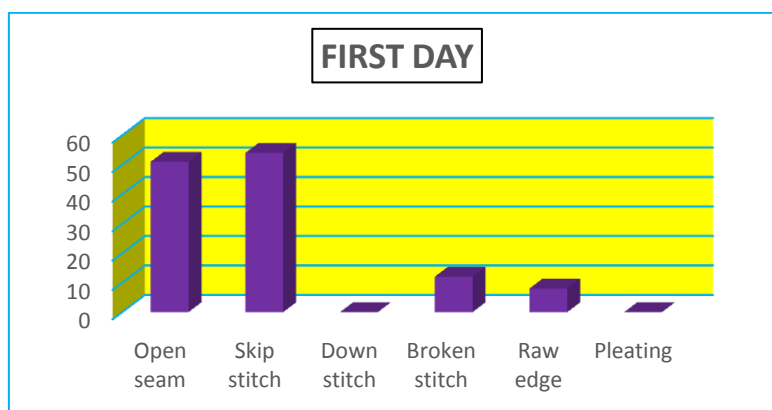
**Figure 8** All faults average rating

Table 15 Fault of first day of our experiment

Date	Open seam	Skip stitch	Down stitch	Broken stitch	Raw edge	Pleating
31-Oct-15	51	54	0	12	8	0

This is our first day experiment data. The graphs show that the higher faults skip stitch value 54, secondary faults is open seam value 51 and the broken stitch value 12 and also raw-edge value 8. We could not found any down stitch and broken stitch faults in our first day experiments.

**Figure 9** Faults first day experiment data

The below table are our last day experimental data. Where as we see that the too much improvement in average rating faults value reports. If we compare with our first day study its vary comparable results. The open seam faults show that the lowest vale than our first day experiment value and the skip stitch also more lowest value. The another faults down stitch, broken stitch, raw-edge and pleating sewing faults value also better improve.

Table 16 Fault of final day of our experiment

Date	Open seam	Skip stitch	Down stitch	Broken stitch	Raw edge	Pleating
31-Oct-15	14	20	5	8	25	0

**Figure 10** Faults final day experiment data

We investigated that the total faults rating value is more improve then the first day experimental data. In this work we analysis how to make quality goods with less sewing faults. And also observation how to remedies of sewing faults and rework cost saving. The faults value decrease means ultimately production quality is increase. The minimizing of sewing fault in the sewing section of apparel industries by ensuring quality production. Sewing fault increases the cost of the product and also increase the wastes of time. Finally, we achieved our goals less sewing faults percentage with good quality products. The below table show that the total faults value and total time required for rework. And also mentioned the total cost per month per faults average cost and how much losses in yearly for rework.

Table 17 Calculation of fault losses

Faults Name	Total losses of minutes per faults	Total cost Per month	Total losses of per yearly per faults	Total losses of average cost for Six faults
open seam	771	2829.6	33955.2	
skip stitch	899	3299	39588	
Down stitch	85	312	3744	
Broken stitch	256.3	940.4	11284.8	144503.12
Raw edge	1266.5	4597.396	55168.752	
Pleating	17.5	63.53	762.36	

4. Conclusion

The suggestive tools developed in this project cover a comprehensive series of aspects in minimizing sewing fault in the sewing section of apparel industries by ensuring quality production. The importance of the textile industry in the economy of Bangladesh is very high. The explosive growth of the RMG industry in the country, however, has not been enough supported by the growth of backward linkage facilities. So manufacturing the quality product is mandatory to sustain in this global competitive market. Quality is ultimately a question of customer satisfaction. Good Quality increases the value of a product or service, establishes brand name, and builds up good reputation for the garment exporter, which in turn results into consumer satisfaction, high sales and foreign exchange for the country. The perceived quality of a garment is the result of a number of aspects, which together help achieve the desired level of satisfaction for the customer. However, we should bear in mind that 1% defective product for an organization is 100% defective for the customer who buys that defective product. The project clearly indicates that by eliminating non-productive activities like uncut thread, open seam, skip stitch, oil stain, dirty spot, etc in the apparel industries time as well as cost is saved by ensuring quality production which have an important impact on overall factory economy.

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